

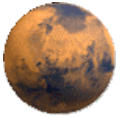
Mars Miniature Science Instruments

**Soon Sam Kim and Samad Hayati,
JPL**

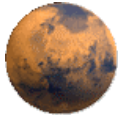
**David Lavery and Karen S. McBride,
NASA HQ**



Mars Instrument Development Project (MIDP)

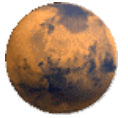


- **Selection by NASA NRA Process**
 - Per Science priorities of MEPAG (Mars Exploration Program Analysis Group)
- **Objectives**
 - Development of laboratory demonstrated miniature in-situ instruments (TRL 3,4) into Space Qualifiable Hardware (TRL 5,6) ready for response to Mars Flight AO.
 - To bridge the existing gap between instrument R&D programs (e.g., PIDDP, ASTID) and hardware requirements for flight programs.
 - Matured instruments are integration field tested with a rover for compatibility.
- **Participants**
 - Open to all domestic organizations; university, NASA centers, FFRDC, industry



Science Focus of MIDP

- **MIDP I (NRA-97-OSS-16)**
 - Instruments for Mars 03 and 05 Missions
- **MIDP II (NRA-02-OSS-01 MIDP) & MIDP III (NRA-03-OSS-01-MIDP)**
 - Instruments for MSL and Mars Scout Missions

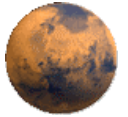


MIDP Instrument Selection Criteria

- **Intrinsic Science and Technical Merit**
- **Relevance to NASA Objectives**
 - **Per MEPAG Priorities**
- **Realistic and Reasonable Cost**
 - **Selection from Breadboard Instruments (TRL 3,4) developed to Space Qualifiable Instruments (TRL 5,6)**
 - **Duration; 1, 2 or 3 years**
- **Education/Public Outreach**



MIDP



BACKGROUND

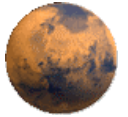
- Most of the existing instrument R&D programs (e.g., PIDDP) only support up to breadboard level (TRL 3,4) and there is a need to carry such instruments to flight qualifiable status (TRL 5,6) to respond to flight AO.
- The flight AO has only limited time and financial resources, and can not afford such hardware development processes.

APPROACH

- Candidate Instruments are Selected through NASA NRA Process: FY1998, 10 (ROSS 1997), FY2002, 16 (ROSS 2002) and FY2003, 11 (ROSS 2003) Instruments have been selected.
- Working with PIs, JPL has been Managing the MIDP Tasks since September 1998. JPL works as a technical guide to MIDP PIs.
- Matured instruments are integration field tested with a rover (K9 Rover, FIDO, Rocky 7 or Rocky 8) for compatibility.

SIGNIFICANCE

- All the instruments being developed under MIDP have been selected through a highly competitive NRA process, and employ state-of-the-art technology. When matured, the instruments will significantly enhance In-Situ Mars Exploration capability.
- 4 MIDP Instruments selected for Mars Missions: MSL 3, Mars Scout 1.



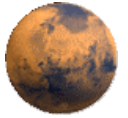
MIDP Participation (PI Institutions)

	MIDP I 1998–2001	MIDP II 2003–2005	MIDP III 2004–2006
University	3	4	3
Industry	2	3	2
FFRDC	2	1	1
NASA Centers	3	8	5
Total	10	16	11
Total Funding	\$7M	\$17M	\$10M



MIDP Instruments

(Science Category)



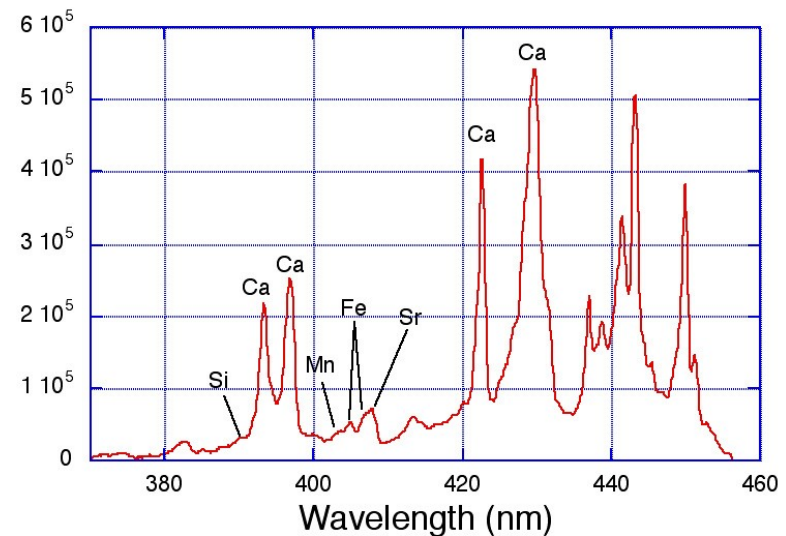
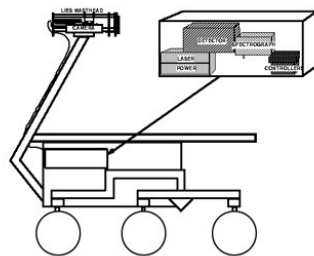
Instrument Science Category	MIDP I 1998–2001	MIDP II 2003–2005	MIDP III 2004–2006
Characterization of Martian Atmosphere	0	3	2
Elemental Analysis	1	0	2
Characterization of Martian Surface Materials	2	2	0
Imaging Spectrometer	1	1	0
Age Dating Surface Materials	0	1	0
Mineralogy	2	3	1
Water Detection	0	2	1
Imager/Camera	2	0	0
Rock Surface Preparation	1	0	0
Subsurface Geology	0	2	1
Subsurface Access with Integrated Instrument	1	1	4
Integrated Instrument Package	0	1	0
Total Instruments	10	16	11



Rover Integration Field Testing LIBS/K-9

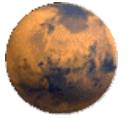


PI, David Cremers, Roger Wiens (MIDP I)



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Rover Integration Field Testing

Abrasive Jet Polisher/Rocky-8

PI, Stephen Fuerstenau (MIDP I)

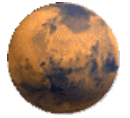


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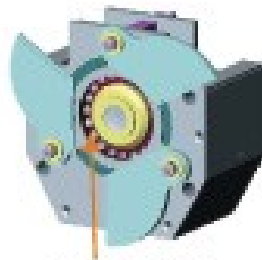
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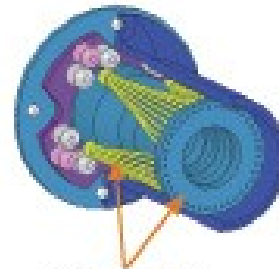
Rover Integration Field Testing CHAMP/K-9



PI, George Lawrence (MIDP II)



MIDP CHAMP
LED system



MSL CHAMP
LED/Fiberoptic Illumination



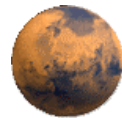
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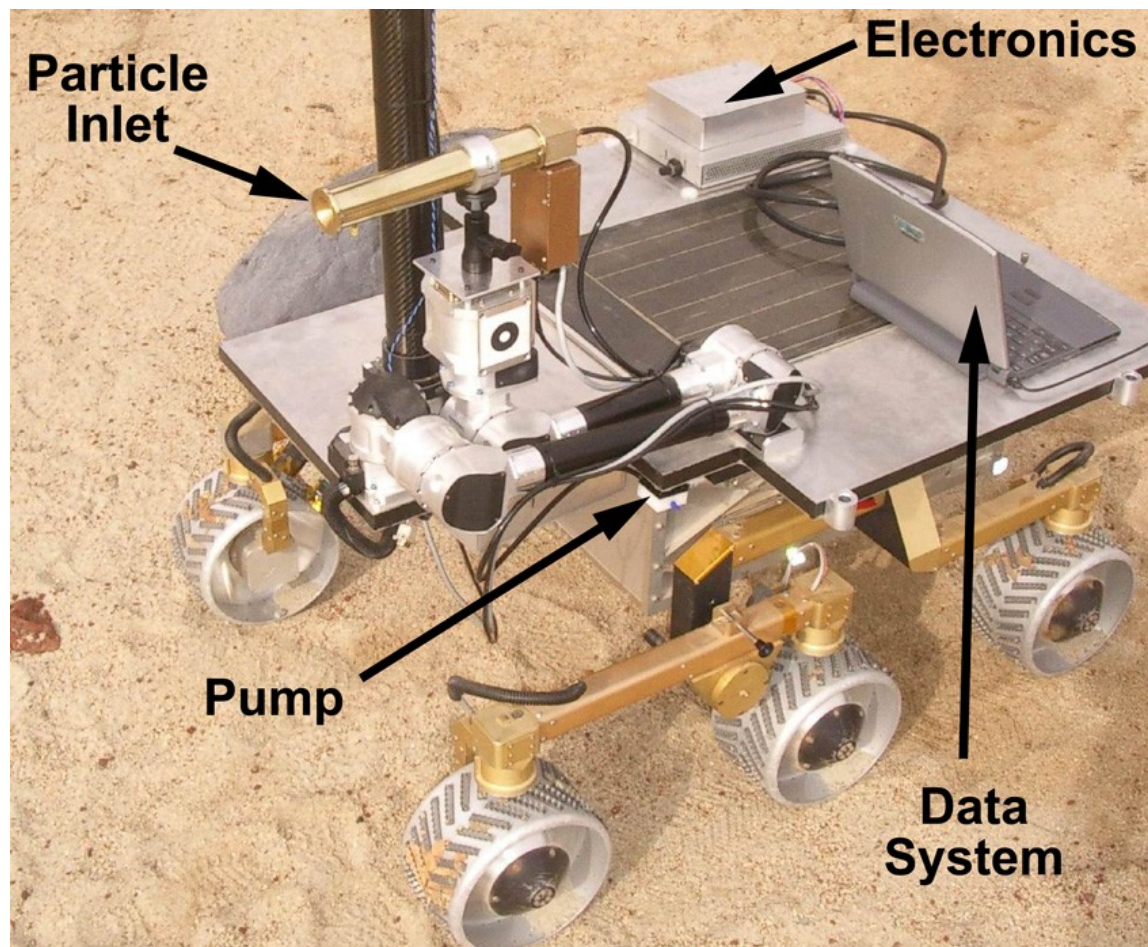


Rover Integration Field Testing

Particle Charge Spectrometer/Rocky-8



PI, Stephen Fuerstenau



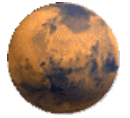
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Rover Integration Field Testing

Raman Spectrometer/Rocky-8



PI, Bruce McIntosh (MIDP II)

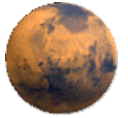


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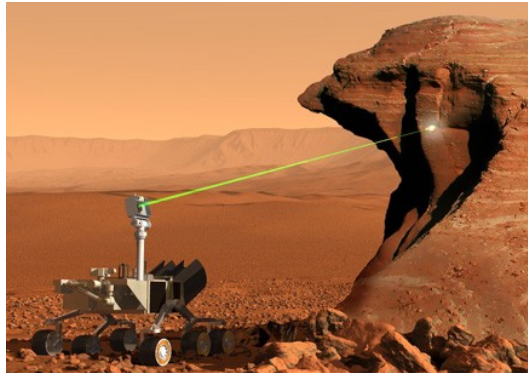
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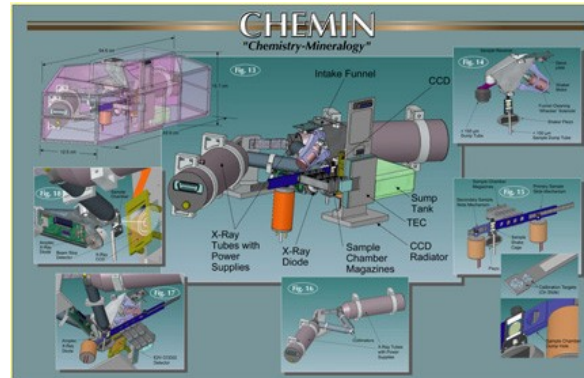
MSL MIDP Instruments



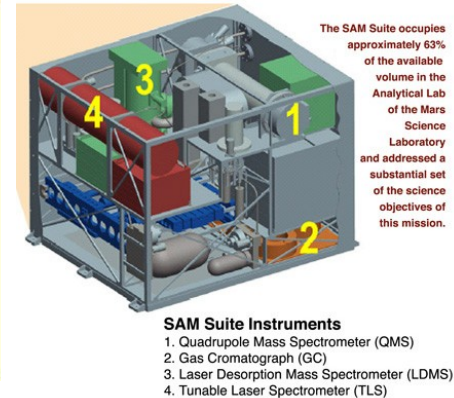
LIBS



CHEMIN



SAM



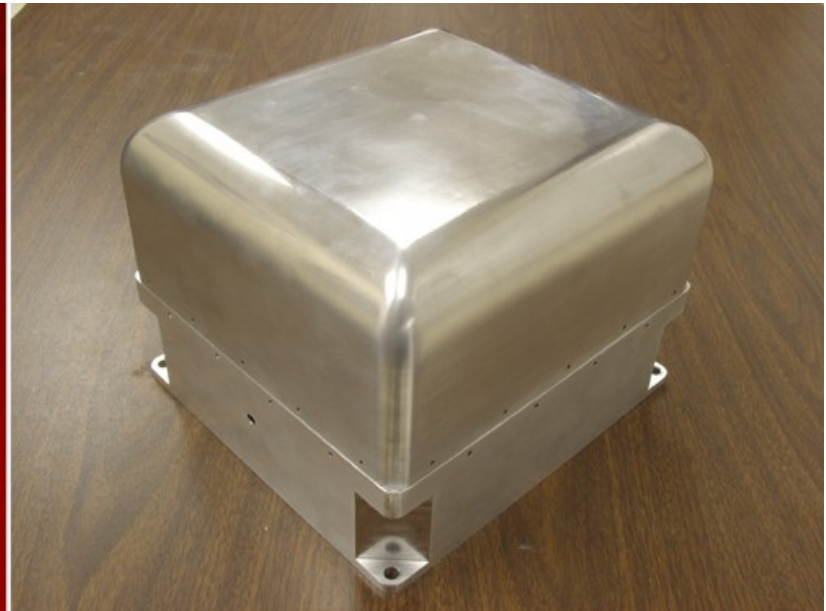
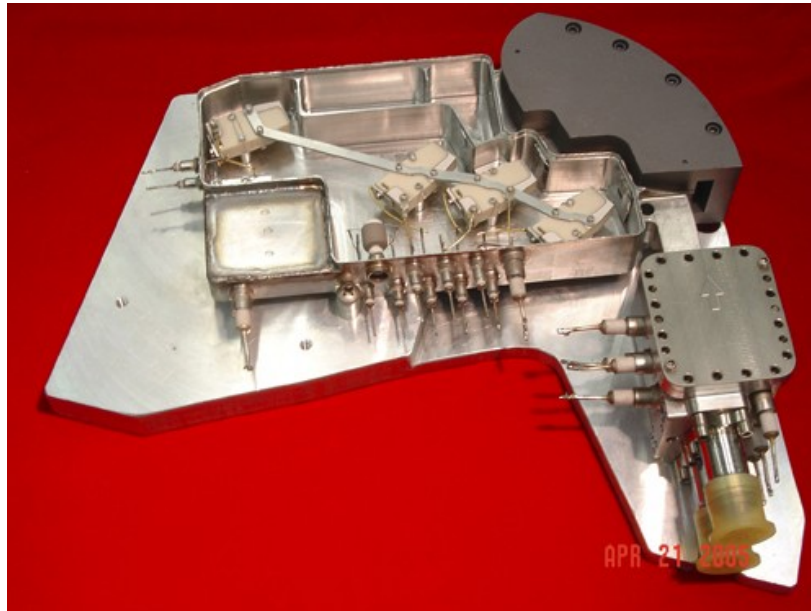
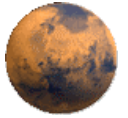
MIDP III
PI, Roger Wiens
Elemental Analysis

MIDP II
PI, David Blake
XRF/XRD

MIDP II
PI, Paul Mahaffy
Sample Analysis
at Mars



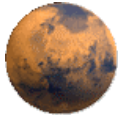
Mars Scout Phoenix Instrument REGA Mass Analyzer



MIDP I
PI, John Hoffman

March 6, 2006

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Conclusions

- **MIDP has produced state-of-the art miniature in-situ instruments for Mars Missions**
- **Served as bridging the gap between the instrument R&D programs and construction of flight hardware**
- **Unique source of new instruments that can save time and funding for Mars Missions**